If a telephone conference would be helpful in resolving any issues concerning this communication, please contact Applicants' primary attorney-of record, Gregory A. Sebald (Reg. No. 33,280), at (612) 336-4728.

Respectfully submitted,

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By _____
Gregory A. Sebald
Reg. No. 33,280

GAS/tvm/kmg

OPTICAL DEVICE

Michael D. GOLDSTEIN, Avi YARON and Shay GHILAI

FIELD OF THE INVENTION

The present invention relates to endoscopes, microscopes and boroscopes, in general and to stereoscopic image pick up devices with color imaging capability, in particular.

BACKGROUND OF THE INVENTION

Stereoscopic image detection devices are known in the art. Such devices are required to obtain and provide a combination of small cross section and high image quality. It will be appreciated by those skilled in the art that high image quality, in general, is characterized by stereoscopic vision accuracy, color capabilities, high resolution and illumination requirements.

It is noted that conventional methods, which provide stereoscopic images, require a wider optical path than a monocular one. Such a widened optical path enlarges the cross-section required for the detection device considerably. Hence, the requirement for a small cross section is not maintained.

US Patent No. 5,527,263 to ~~Jurgen~~Zobel et al., is directed to a dual optical path stereo endoscope with simple optical adjustment. US Patent No. 5,776,049 to Takahashi, is directed to a "Stereo Endoscope in Stereo Endoscope Imaging Apparatus" and provides a device which utilizes a combination of two optical paths with two CCD units, capable of variable zoom.

Auto-stereoscopic devices, which utilize one optical system to provide a stereo effect, are also known in the art. Such a device is provided in US patent No. 5,603,687 to Hori, which is directed to a device

with two parallel optical axes and two CCD elements. Hori selected an asymmetrical approach, wherein one optical channel has a large aperture for light and details, and the other optical channel provides a parallax image for stereoscopic imagery to the proximal CCD.

US patent No. 5,613,936 to Czarnek, is directed to a stereoscopic endoscope device which utilizes light polarization and time multiplexing, in order to transmit each different polarized image corresponding to left and right images multiplexed in time, through one optical channel that transfers images from the lateral side of the endoscope shaft. This endoscope has to be inserted deeper into the human cavity to receive a stereo image. It must also be used with a head mounted display device called "switched shutter glasses" that causes eye irritation. It is noted that according to Czarnek each image is received in 25% of original quality. As much as 50% of the light received from the object, is lost due to polarization considerations and as much as 50% of the remaining information is lost due to channel switching.

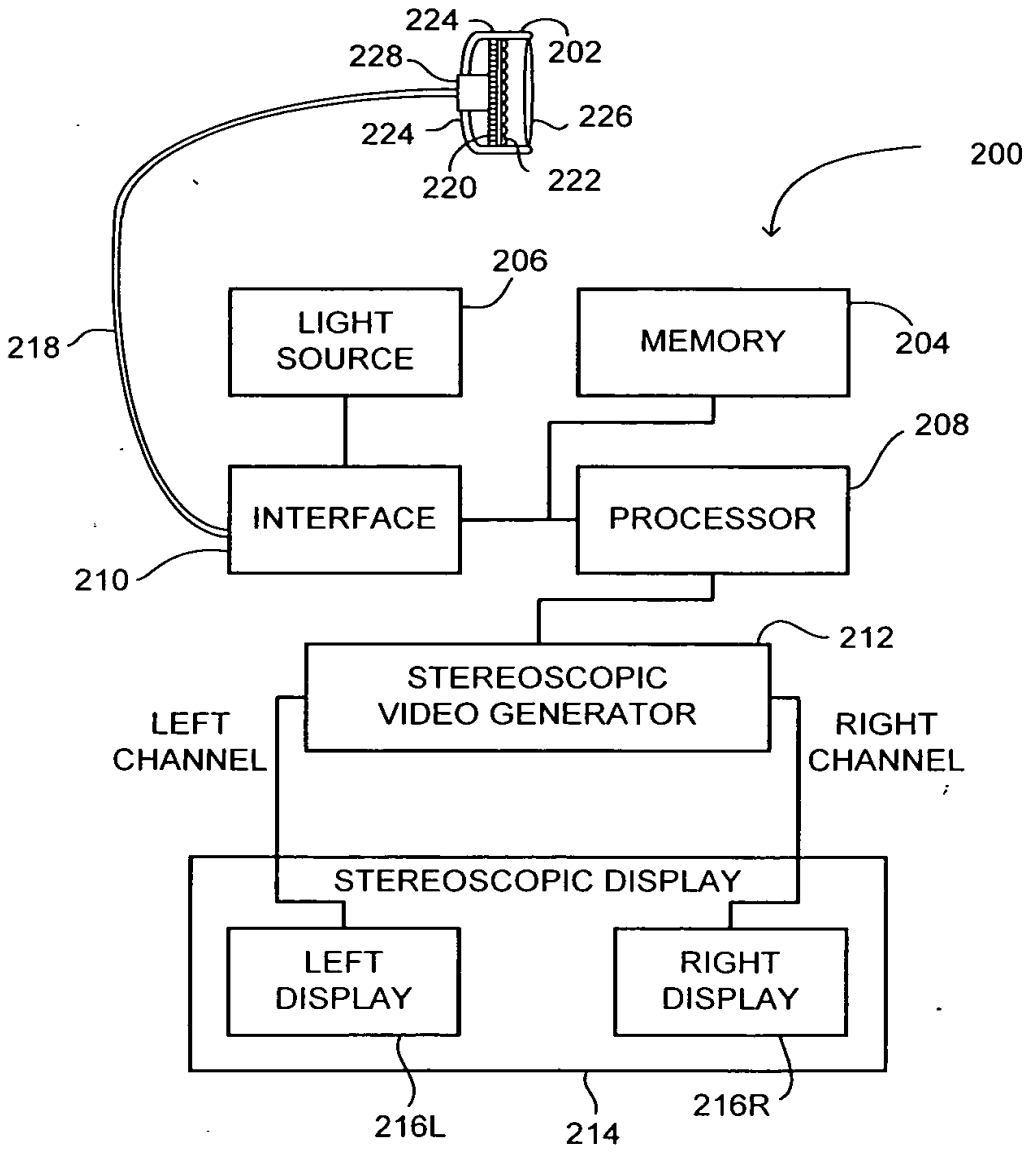
US patent No. 5,588,948, to ~~Susumu~~Takahashi et al., is directed to a stereoscopic endoscope. The stereo effect is produced by having a dividing pupil shutter, which splits the optical path onto the left and right sides, and the up and down sides. These sides are alternately projected on a proximal image pick up device, using time multiplexing. According to another aspect of this reference a distal CCD is included, which is divided to left and right sides with a shading member separating them, for achieving space multiplexing.

U.S. patent No. 5,743,847 to Nakamura et al., is directed to a "Stereoscopic Endoscope Having Image Transmitting Optical-System and Pupil Dividing Unit that are Axially Movable With Respect to Each Other", which uses a plural pupil dividing means and one optical channel. U.S. patent No. 5,751,341 to Chaleki et al, is directed to a "Stereoscopic

NEW CLAIM 8 FOR SUBMISSION

8. The stereoscopic device according to claim 1, wherein said ~~light illuminating unit~~ controllable multi wavelength illumination unit produces at least two alternating beams of light, each said beams of light characterized as being in a different range of wavelengths.

OLD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INTERFACE
PROCESSOR
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212
STEREOSCOPIC VIDEO GENERATOR
LEFT CHANNEL
RIGHT CHANNEL
STEREOSCOPIC DISPLAY
LEFT DISPLAY
RIGHT DISPLAY
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216R

FIG. 2

OLD

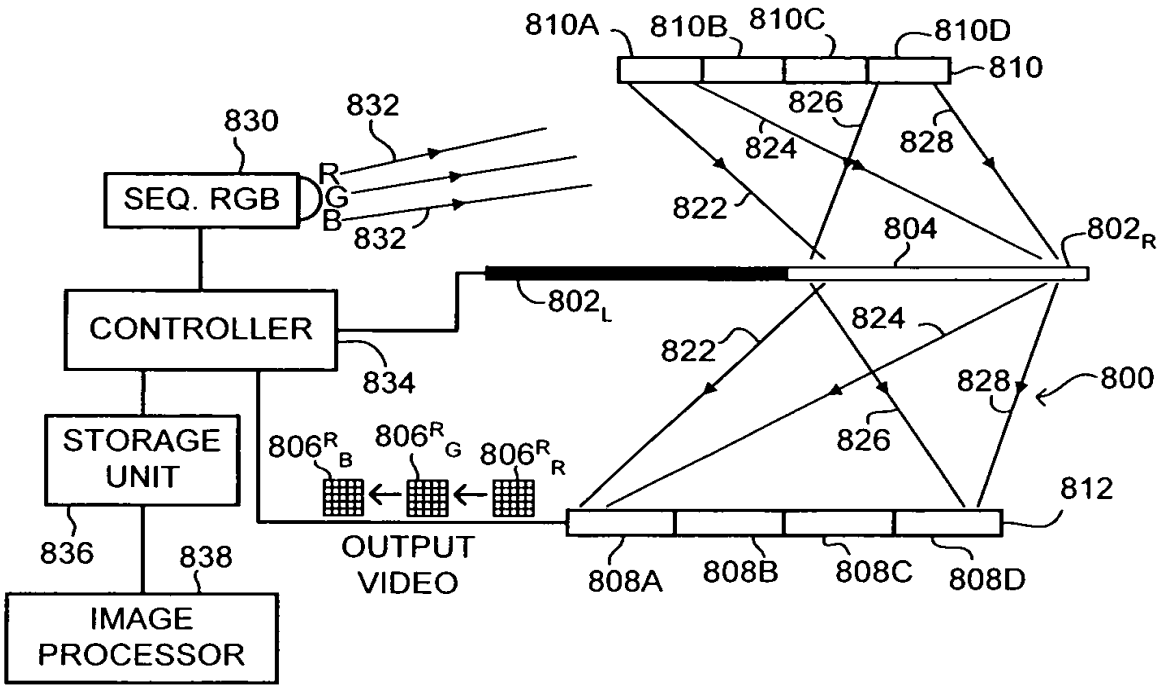


FIG. 20A

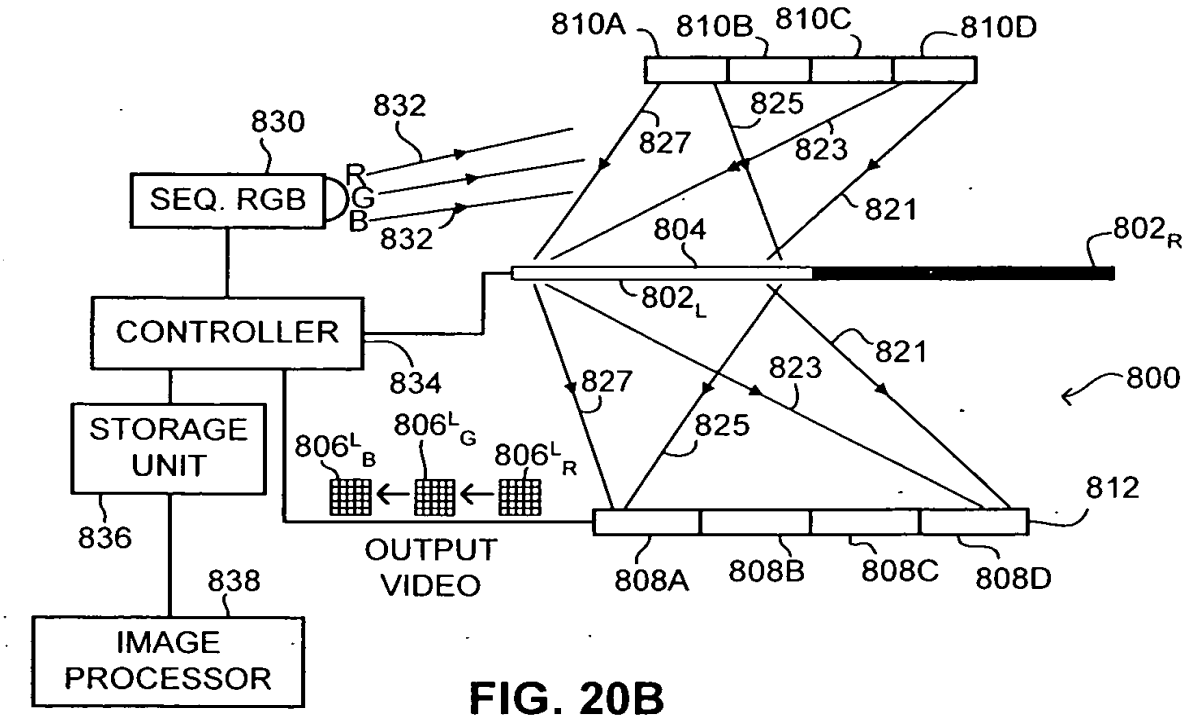
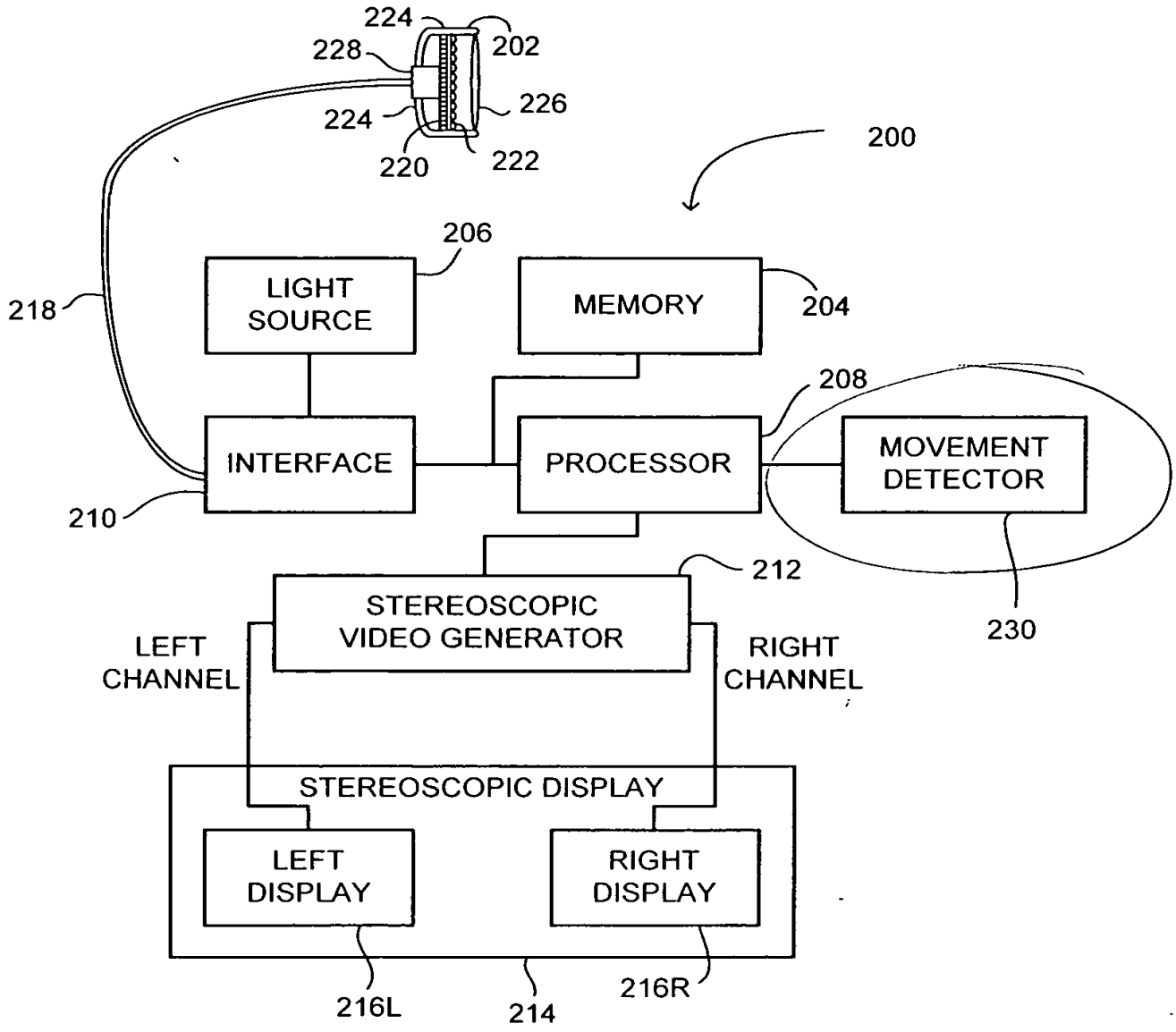


FIG. 20B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MOVEMENT DETECTOR
210
212
STEREOSCOPIC VIDEO GENERATOR
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LEFT CHANNEL
RIGHT CHANNEL
STEREOSCOPIC DISPLAY
LEFT DISPLAY
RIGHT DISPLAY
216L
214
216R

FIG. 2

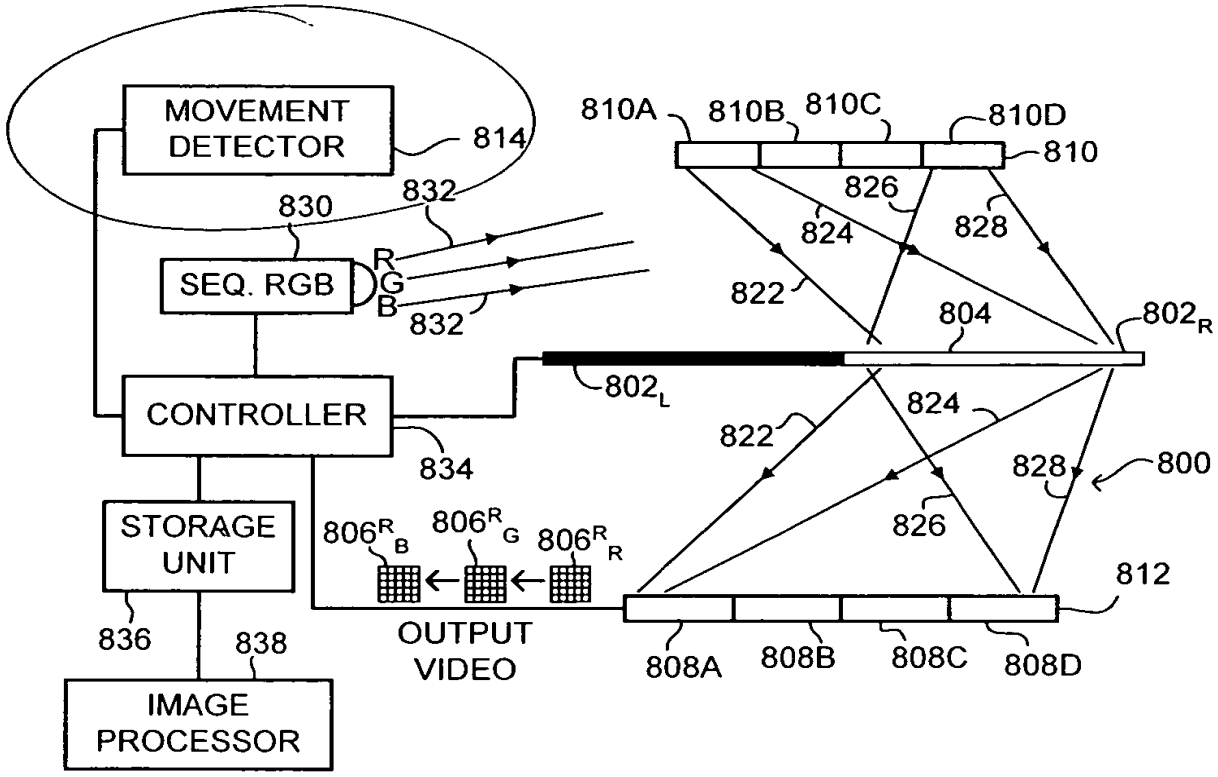

FIG. 20A

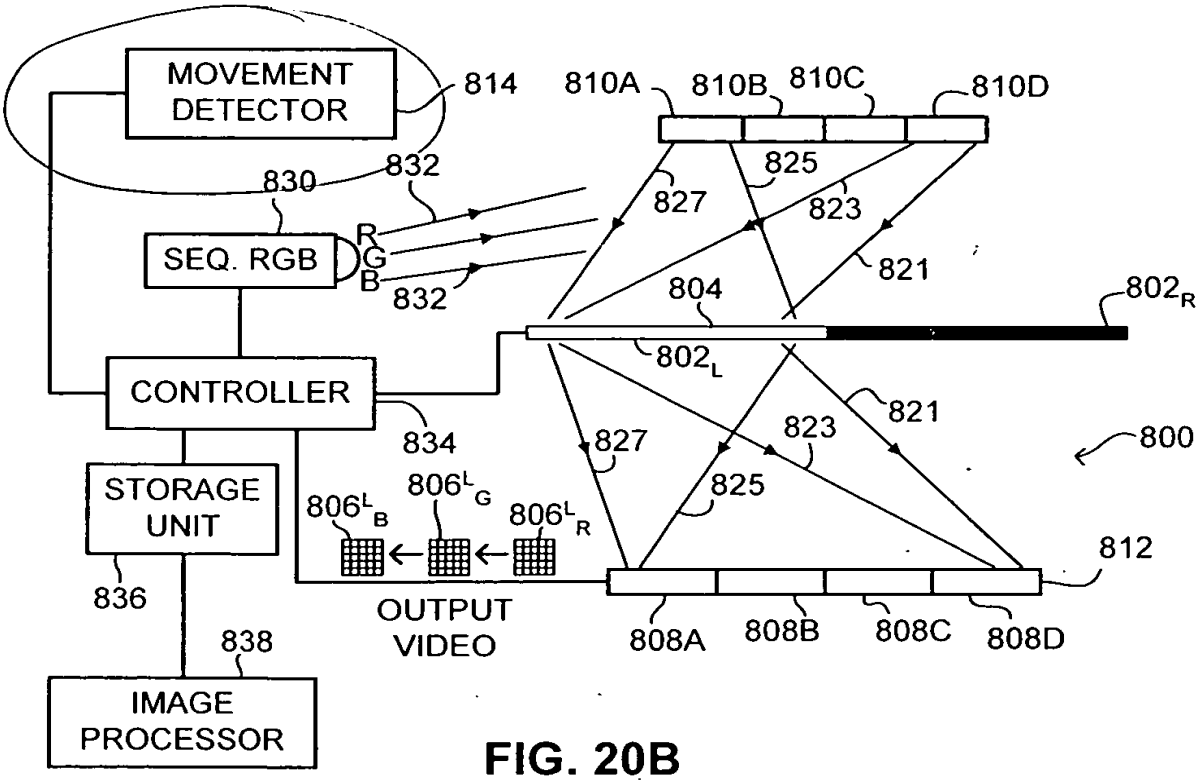

FIG. 20B